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Anderson #3

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U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371

ATTORNEY'S DOCKET NUMBER
024444-497

U S APPLICATION NO (If known, see 37 C F R. 1 5)
09/077,424

INTERNATIONAL APPLICATION NO.	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
PCT/SE96/01578	29 November 1996	30 November 1995

TITLE OF INVENTION
COATED TURNING INSERT AND METHOD OF MAKING IT

APPLICANT(S) FOR DO/EO/US
Per LINDSKOG, Per GUSTAFSON, Björn LJUNGBERG and Åke ÖSTLUND

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☐ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. ☒ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. ☐ This is an express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and the PCT Articles 22 and 39(1).
4. ☐ A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.
5. ☐ A copy of the International Application as filed (35 U.S.C. 371(c)(2))
   - a. ☐ is transmitted herewith (required only if not transmitted by the International Bureau).
   - b. ☐ has been transmitted by the International Bureau.
   - c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US)
6. ☐ A translation of the International Application into English (35 U.S.C. 371(c)(2)).
7. ☐ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))
   - a. ☐ are transmitted herewith (required only if not transmitted by the International Bureau).
   - b. ☐ have been transmitted by the International Bureau.
   - c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
   - d. ☐ have not been made and will not be made.
8. ☐ A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. ☒ An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).
10. ☐ A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

Items 11. to 16. below concern other document(s) or information included:

11. ☒ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
12. ☒ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13. ☐ A FIRST preliminary amendment.
    ☒ A SECOND or SUBSEQUENT preliminary amendment.
14. ☐ A substitute specification.
15. ☐ A change of power of attorney and/or address letter.
16. ☐ Other items or information:

09/04/1998 UWALKER 00000002 09077424
01 FC:154 130.00 OP

U.S. APPLICATION NO (If known, see 37 C F R. 1.50)	INTERNATIONAL APPLICATION NO.	ATTORNEY'S DOCKET NUMBER
09/077,424	PCT/SE96/01578	024444-497

17. ☒ The following fees are submitted:	CALCULATIONS	PTO USE ONLY
Basic National Fee (37 CFR 1.492(a)(1)-(5)):		
Search Report has been prepared by the EPO or JPO $930		
International preliminary examination fee paid to USPTO (37 CFR 1.482) $720.00		
No international preliminary examination fee paid to USPTO (37 CFR 1.482) but international search fee paid to USPTO (37 CFR 1.445(a)(2)) $790.00		
Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO $1070.00		
International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(2)-(4) $98.00		
ENTER APPROPRIATE BASIC FEE AMOUNT =	$	
Surcharge of **$130.00** for furnishing the oath or declaration later than ☐ 20 ☒ 30 months from the earliest claimed priority date (37 CFR 1.492(e)).	$130.00	

Claims	Number Filed	Number Extra	Rate		
Total Claims	14-20 =	0	X$22.00	$ 0	
Independent Claims	2 -3 =	0	X$82.00	$ 0	
Multiple dependent claim(s) (if applicable)			+$270.00	$ 0	
TOTAL OF ABOVE CALCULATIONS =				$ 130.00	
Reduction for 1/2 for filing by small entity, if applicable. Verified Small Entity statement must also be filed. (Note 37 CFR 1.9, 1.27, 1.28).				$	-
SUBTOTAL =				$ 130.00	
Processing fee of **$130.00** for furnishing the English translation later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492(f)). +				$ 0	
TOTAL NATIONAL FEE =				$ 130.00	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). $40.00 per property +				$ 0	
TOTAL FEES ENCLOSED =				$ 130.00	
				Amount to be: refunded	$
				charged	$

a. ☒ A check in the amount of $ 130.00 to cover the above fees is enclosed.

b. ☐ Please charge my Deposit Account No. 02-4800 in the amount of $_____ to cover the above fees. A duplicate copy of this sheet is enclosed.

c. ☒ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 02-4800. A duplicate copy of this sheet is enclosed.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:

Ronald L. Grudziecki
BURNS, DOANE, SWECKER & MATHIS, L.L.P.
P.O. Box 1404
Alexandria, Virginia 22313-1404

SIGNATURE

Ronald L. Grudziecki
NAME

24,970
REGISTRATION NUMBER

Patent
Attorney's Docket No. 024444-497

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of	)	
	)	
Per LINDSKOG et al.	)	Group Art Unit: Unassigned
	)	
Application No.: Unassigned	)	Examiner: Unassigned
	)	
Filed: May 28, 1998	)	
	)	
For: COATED TURNING INSERT AND METHOD OF MAKING IT	)	

PRELIMINARY AMENDMENT

Assistant Commissioner for Patents
Washington, D.C. 20231

Sir:

Prior to examination, please amend the above-identified application as follows:

IN THE SPECIFICATION

Page 1, after the title and before the first paragraph, please add the heading "BACKGROUND OF THE INVENTION";

line 5, please delete "toughness demanding" and insert therefor --toughness-demanding--; and please delete "steels" and insert therefor --steel--;

line 10, after "tools", please insert --,--;

line 13, please delete "so called" and insert therefor --so-called--;

line 17, after "zones", please insert --,--;

line 20, after "steels", please insert --,--; and

line 31, after "9503056-5", please insert --which corresponds to U.S. Serial No. 08/703,965, herein incorporated by reference,--.

Page 2, line 5, after "9504304-8", please insert --which corresponds to U.S. Serial No. _____ filed concurrently herewith (Attorney Docket No. 024444-499),--;

line 19, after "9503056-5", please insert --which corresponds to U.S. Serial No. 08/703,965,--;

line 22, after "316-Ti", please insert --,--;

line 24, after "bars", please insert --,--;

line 25, after "9504304-8", please insert --which corresponds to U.S. Serial No. _____ filed concurrently herewith (Attorney Docket No. 024444-499),--;

line 27, before the paragraph beginning "A turning tool insert", please insert the following:

--OBJECTS AND SUMMARY OF THE INVENTION

It is an object of this invention to avoid or alleviate the problems of the prior art.

It is further an object of this invention to provide a coated cutting tool particularly useful for wet turning of toughness-demanding stainless steel components.

In one aspect of the invention there is provided a cutting tool insert particularly for turning of steel comprising a cemented carbide body and a coating wherein said cemented carbide body contains WC, 6-15 wt-% Co and 0.2-1.8 wt-% cubic carbides

of Ti, Ta and/or Nb and a highly W-alloyed binder phase with a CW-ratio of 0.78-0.93 and said coating comprises

- a first (innermost) layer of $TiC_xN_yO_z$ with a thickness of <1.5 μm, and with equiaxed grains with size <0.5 μm

- a second layer of $TiC_xN_yO_z$ with a thickness of 2-5 μm with columnar grains with an average diameter of <5 μm and

- an outer layer of a smooth, fine-grained (0.5-2 μm) κ-Al_2O_3 with a thickness of 0.5-6 μm.

In another aspect of the invention, there is provided a method of making an insert for turning comprising a cemented carbide body and a coating wherein a WC-Co-based cemented carbide body with a highly W-alloyed binder phase with a CW-ratio of 0.78-0.93 is coated with

- a first (innermost) layer of $TiC_xN_yO_z$ with $x+y+z=1$, with a thickness of 0.1-1.5 μm, with equiaxed grains with size <0.5 μm using known CVD-methods

- a second layer of $TiC_xN_yO_z$ with $x+y+z=1$, with a thickness of 2-8 μm with columnar grains with a diameter of about <5 μm deposited by MTCVD-technique, using acetonitrile as the carbon and nitrogen source for forming the layer in a preferred temperature range of 850-900°C and

- a layer of a smooth κ-Al_2O_3 with a thickness of 0.5-6 μm.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS OF THE INVENTION--;

line 30, please delete "well balanced" and insert therefor --well-balanced--;

and

lines 33-34, after "with", please insert --,--; after "e.g.", please insert --,--; and please delete "SiC based" and insert therefor --SiC-based--.

Page 3, line 4, please delete "magnetisation" and insert therefor --magnetization--;

line 9, after "invention", please insert --,--;

line 12, after "invention", please insert --,--; and

line 13, please delete "is provided".

Page 4, line 9, please delete "stabilised" and insert therefor --stabilized--;

lines 15-16, please delete "μ m" and insert therefor --μm--;

line 23, after "invention", please insert --,--; and

line 30, after "Co", please insert --,--; and after "Co-content", please insert --,--.

Page 5, line 13, after "in", please insert --,--; and after "e.g.--, please insert --,--;

lines 14-15, after "EP-A-523 021", please insert --which corresponds to U.S. Patent No. 5,674,564, herein incorporated by reference--; and please delete "μ m" and insert therefor --μm--;

lines 21-22, after "wet-blasting", please insert --of--; and please delete "fine grained" and insert therefor --fine-grained--;

line 25, after "9402543-4", please insert --which corresponds to U.S. Serial No. 08/497,934, herein incorporated by reference--; and

after line 26, please insert the following new paragraph:

--The invention is additionally illustrated in connection with the following Examples which are to be considered as illustrative of the present invention. It should be understood, however, that the invention is not limited to the specific details of the Examples.--.

Page 6, line 3, after "process", please insert --,--;

line 4, after "EP-A-523 021", please insert --which corresponds to U.S. Patent No. 5,674,564, was used--;

line 7, please delete "SiC containing" and insert therefor --SiC-containing--;

line 19, after "process", please insert --,--;

line 20, after "EP-A-523 021", please insert --which corresponds to U.S. Patent No. 5,674,564, was used--; and

line 23, please delete "SiC containing" and insert therefor --SiC-containing--.

Page 10, after the last paragraph ending at line 14, please insert the following new paragraph:

--The principles, preferred embodiments and modes of operation of the present invention have been described in the foregoing specification. The invention which is intended to be protected herein, however, is not to be construed as limited to the particular forms disclosed, since these are to be regarded as illustrative rather than restrictive.

Variations and changes may be made by those skilled in the art without departing from the spirit of the invention.--.

IN THE CLAIMS

Claim 1 (amended) A cutting tool insert particularly for turning of steel comprising a cemented carbide body and a coating [characterized in that] wherein said cemented carbide body [consists of] contains WC, 6-15[, preferably 9-12,] wt-% Co and 0.2-1.8-wt % cubic carbides of Ti, Ta and/or Nb and a highly W-alloyed binder phase with a CW-ratio of 0.78-0.93[,preferably 0.80-0.91] and [in that] said coating comprises

- a first (innermost) layer of $TiC_xN_yO_z$ with a thickness of <1.5 μm, and with equiaxed grains with size <0.5 μm

- a second layer of $TiC_xN_yO_z$ with a thickness of 2-5 μm with columnar grains with an average diameter of <5 μm and

- an outer layer of a smooth, fine-grained (0.5-2 μm) κ-Al_2O_3[-layer] with a thickness of 0.5-6 μm.

Claim 2 (amended) The [C]cutting tool insert [according to any of the preceding claims characterized in that the] of claim 1 further comprising an outermost layer [is] of a thin 0.1-1 μm TiN-layer.

Claim 3 (amended) The [C]cutting tool insert [according to] of claim 2 [characterized in that] wherein the outermost TiN-layer has been removed along the cutting edge.

Claim 4 (amended) A [M]method of making an insert for turning comprising a cemented carbide body and a coating [characterized in that] wherein a WC-Co-based cemented carbide body with a highly W-alloyed binder phase with a CW-ratio of 0.78-0.93 is coated with

- a first (innermost) layer of $TiC_xN_yO_z$ with $x+y+z=1$, [preferably $z<0.5$,] with a thickness of 0.1-1.5 μm, with equiaxed grains with size <0.5 μm using known CVD-methods

- a second layer of $TiC_xN_yO_z$ with $x+y+z=1$, [preferably with $z=0$ and $x>0.3$ and $y>0.3$,] with a thickness of 2-8 μm with columnar grains with a diameter of about <5 μm deposited by MTCVD-technique, using acetonitrile as the carbon and nitrogen source for forming the layer in a preferred temperature range of 850-900°C[.] and

- a layer of a smooth κ-Al_2O_3 with a thickness of 0.5-6 μm[and

-preferably a layer of TiN with a thickness of <1 μm].

Claim 5 (amended) The [M]method [according to the previous claim] of claim 4 wherein [characterized in that] said cemented carbide body has a cobalt content of 9-12 wt% and 0.4-1.8 wt% cubic carbides of Ta and Nb.

Claim 6 (amended) The [M]method [according to the claim 4 or 5] of claim 5 wherein [characterized in that] said cemented carbide body has a cobalt content of 10-11 wt%.

Claim 7 (amended) The [M]method [according to the claim 4, 5 or 6] of claim 4 wherein the [characterized in a] CW-ratio [of] is from 0.82-0.90.

Claim 8 (amended) The [M]method [according to any of the claims 4, 5, 6 and 7] of claim 4 further comprising an [characterized in that the] outermost TiN-layer[, if present,] which is removed along the cutting edge.

Please add the following new claims 9-14.

--9. The cutting tool insert of claim 1 wherein said cemented carbide body contains 9-12 wt% Co and the CW ratio is 0.80-0.91.

10. The cutting tool insert of claim 1 wherein in the first (innermost) layer of $TiC_xN_yO_z$, $z<0.5$ and in the second layer of $TiC_xN_yO_z$, $z=0$, $x>0.3$ and $y>0.3$.

11. The method of claim 4 wherein in the first (innermost) layer of $TiC_xN_yO_z$, $z<0.5$ and in the second layer of $TiC_xN_yO_z$, $z=0$, $x>0.3$ and $y>0.3$.

12. The method of claim 4 wherein the insert contains an outermost layer of TiN with a thickness of <1 μm.

13. The method of claim 12 wherein the CW ratio ranges from 0.82-0.90.

14. The method of claim 12 wherein the outermost TiN-layer is removed along the cutting edge.--

IN THE ABSTRACT OF THE DISCLOSURE

The above-identified application does not contain an Abstract of the Disclosure. Please add the attached Abstract of the Disclosure.

REMARKS

The amendments to the above-identified application are clerical in nature and have been made to place the application in the accepted U.S. format. The new claims have been added to more clearly reflect Applicant's invention and an Abstract of the Disclosure has been included. No new matter has been added.

Early examination and allowance of the claims is earnestly solicited.

Respectfully submitted,

BURNS, DOANE, SWECKER & MATHIS, L.L.P.

By: Ronald L. Grudziecki Reg No. 31917
Ronald L. Grudziecki
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Date: May 28, 1998

PCT/SE96/01578

09/077424

COATED TURNING INSERT AND METHOD OF MAKING IT

The present invention relates to a coated cutting tool (cemented carbide insert) particularly useful for wet turning of toughness demanding stainless steels components like square bars, flanges and tubes, with raw surfaces such as cast skin, forged skin, hot or cold rolled skin or pre-machined surfaces.

When turning stainless steels with cemented carbide tools the cutting edge is worn according to different wear mechanisms, such as adhesive wear, chemical wear, abrasive wear and by edge chipping caused by cracks formed along the cutting edge, the so called comb cracks.

Different cutting conditions require different properties of the cutting insert. For example, when cutting in steels with raw surface zones a coated cemented carbide insert must consist of a tough carbide and have very good coating adhesion. When turning in stainless steels the adhesive wear is generally the dominating wear type.

Measures can be taken to improve the cutting performance with respect to a specific wear type. However, very often such action will have a negative effect on other wear properties.

So far it has been very difficult to improve all tool properties simultaneously. Commercial cemented carbide grades have therefore been optimised with respect to one or few of the wear types and hence to specific application areas.

Swedish patent application 9503056-5 discloses a coated cutting insert particularly useful for turning in hot and cold forged low alloyed steel components. The inserts is characterised by a cemented carbide substrate consisting of Co-WC and cubic carbides having a 15-35 µm

#3

Patent
Attorney's Docket No. 024444-497

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of	)	
	)	
Per LINDSKOG et al.	)	Group Art Unit: Unassigned
	)	
Application No.: 09/077,424	)	Examiner: Unassigned
	)	
Filed: May 28, 1998	)	
	)	
For: COATED TURNING INSERT AND METHOD OF MAKING IT	)	

SUPPLEMENTAL PRELIMINARY AMENDMENT

Assistant Commissioner for Patents
Washington, D.C. 20231

Sir:

Prior to examination, and further to the Preliminary Amendment filed May 28, 1998, please amend the above-identified application as follows:

IN THE SPECIFICATION

Page 2, lines 5 and 25, please add the serial number for the concurrently filed application, "09/077,360".

REMARKS

The amendments to the above-identified application are clerical in nature and add updated information in regard to the serial number to the concurrently filed application cited in the above-identified specification. No new matter has been added.

Early examination and allowance of the claims is earnestly solicited.

Respectfully submitted,

BURNS, DOANE, SWECKER & MATHIS, L.L.P.

By: _____
Ronald L. Grudziecki
Registration No. 24,970

P.O. Box 1404
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(703) 836-6620

Date: September 1, 1998

thick surface zone depleted from cubic carbides, a coating including a layer of $TiC_xN_yO_z$ with columnar grains, a layer of smooth, fine grained κ-Al_2O_3, and preferably an outer layer of TiN.

Swedish patent application 9504304-8 discloses a coated cutting insert particularly useful for wet and dry milling of low and medium alloyed steels. The insert is characterised by a cemented carbide substrate consisting of Co-WC and cubic carbides, a coating including a layer of $TiC_xN_yO_z$ with columnar grains, a layer of smooth, fine grained κ-Al_2O_3 and preferably an outer layer of TiN.

It has now been found that combinations of the substrates and coatings described in the above patent applications give rise to excellent cutting performance in stainless steels turning. A cemented carbide substrate with a cubic carbide depleted surface zone combined with a coating in accordance with patent application, 9503056-5, has been found to be especially suitable for high speed turning in easy stainless steel, such as turning of machineability improved 304L, In more difficult work piece materials such as 316-Ti and in operations with a high degree of thermal cycling such as turning of square bars a straight WC-Co substrate of the type described in patent application 9504304-8 has been found the most suitable.

A turning tool insert according to the invention useful for turning of steel consists of a cemented carbide substrate with a highly W-alloyed binder phase and with a well balanced chemical composition and grain size of the WC, a columnar $TiC_xN_yO_z$-layer, a κ-Al_2O_3-layer, a TiN-layer and optionally followed by smoothening the cutting edges by brushing the edges with e.g. a SiC based brush.

The cobalt binder phase is highly alloyed with W. The content of W in the binder phase can be expressed as the CW-ratio= M_S / (wt% Co · 0.0161), where M_S is the measured saturation magnetisation of the cemented carbide substrate in kA/m and wt% Co is the weight percentage of Co in the cemented carbide. The CW-value is a function of the W content in the Co binder phase. A low CW-value corresponds to a high W-content in the binder phase. According to the present invention improved cutting performance is achieved if the cemented carbide substrate has a CW-ratio of 0.78-0.93.

According to the present invention a turning tool insert is provided particularly useful for difficult stainless steel turning is provided with a cemented carbide substrate with a composition of 6-15 wt% Co, preferably 9-12 wt% Co, most preferably 10-11 wt% Co, 0.2-1.8 wt% cubic carbides, preferably 0.4-1.8 wt% cubic carbides, most preferably 0.5-1.7 wt% cubic carbides of the metals Ta, Nb and Ti and balance WC. The cemented carbide may also contain other carbides from elements from group IVb, Vb or VIb of the periodic table. The content of Ti is preferably on a level corresponding to a technical impurity. The preferred average grain size of the WC depend on the binder phase content. At the preferred composition of 10-11 wt-% Co, the preferred grain size is 1.5-2 µm, most preferably about 1.7 µm. The CW-ratio shall be 0.78-0.93, preferably 0.80-0.91, and most preferably 0.82-0.90. The cemented carbide may contain small amounts, <1 volume %, of η-phase (M_6C), without any detrimental effect. From the CW-value it follows that no free graphite is allowed in the cemented carbide substrate according to the present embodiment.

The coating comprises

- a first (innermost) layer of $TiC_xN_yO_z$ with x+y+z=1, preferably z<0.5, with equiaxed grains with

size <0.5 μm and a total thickness <1.5 μm and preferably >0.1 μm.

- a layer of $TiC_xN_yO_z$ with x+y+z=1, preferably with z=0 and x>0.3 and y>0.3, with a thickness of 1-15 μm, preferably 2-8 μm, with columnar grains and with an average diameter of <5 μm, preferably 0.1-2 μm. Most preferred thickness of the $TiC_xN_yO_z$ layer is 2-5 μm, particularly in extremely edgeline-toughness demanding work-piece materials such as Ti-stabilised stainless steel.

- a layer of a smooth, fine-grained (grain size about 0.5-2 μm) Al_2O_3 consisting essentially of the κ-phase. However, the layer may contain small amounts, 1-3 vol-%, of the θ- or the α-phases as determined by XRD-measurement. The Al_2O_3-layer has a thickness of 0.5-6 μm, preferably 0.5-3 μm, and most preferably 0.5-2 μm. Preferably, this Al_2O_3-layer is followed by a further layer (<1 μm, preferably 0.1-0.5 μm thick) of TiN, but the Al_2O_3 layer can be the outermost layer. This outermost layer, Al_2O_3 or TiN, has a surface roughness R_{max}<0.4 μm over a length of 10 μm. The TiN-layer, if present, is preferably removed along the cutting edge.

According to the method of the invention a WC-Co-based cemented carbide substrate is made with a highly W-alloyed binder phase with a CW-ratio of 0.78-0.93, preferably 0.80-0.91, and most preferably 0.82-0.90, a content of cubic carbides of 0.2-1.8 wt%, preferably 0.4-1.8 wt%, most preferably 0.5-1.7 wt% of the metals Ta, Nb and Ti, with 6-15 wt% Co, preferably 9-12 wt% Co, most preferably 10-11 wt% Co at which Co-content the WC grain size 1.5-2 μm, most preferably about 1.7 μm. The body is coated with:

- a first (innermost) layer of $TiC_xN_yO_z$ with x+y+z=1, preferably z<0.5, with a thickness of <1.5 μm,

and with equiaxed grains with size <0.5 µm using known CVD-methods.

- a layer of $TiC_xN_yO_z$ x+y+z=1, preferably with z=0 and x >0.3 and y>0.3, with a thickness of 1-13 µm, preferably 2-8 µm, with columnar grains and with an average diameter of <5 µm, preferably <2 µm, using preferably MTCVD-technique (using acetonitrile as the carbon and nitrogen source for forming the layer in the temperature range of 700-900 °C). The exact conditions, however, depend to a certain extent on the design of the equipment used.

- a smooth Al_2O_3-layer essentially consisting of κ-Al_2O_3 is deposited under conditions disclosed in e.g. EP-A-523 021. The Al_2O_3 layer has a thickness of 0.5-6 µm, preferably 0.5-3 µm, and most preferably 0.5-2 µm. Preferably, a further layer (<1 µm, preferably 0.1-0.5 µm thick) of TiN is deposited, but the Al_2O_3 layer can be the outermost layer. This outermost layer, Al_2O_3 or TiN, has a surface roughness R_{max}<0.4 µm over a length of 10 µm. The smooth coating surface can be obtained by a gentle wet-blasting the coating surface with fine grained (400-150 mesh) alumina powder or by brushing (preferably used when TiN top coating is present) the edges with brushes based on SiC as disclosed in Swedish patent application 9402543-4. The TiN-layer, if present, is preferably removed along the cutting edge.

Example 1

A. A cemented carbide turning tool insert in style CNMG120408-MM with the composition 10.5 wt-% Co, 1.16 wt-% Ta, 0.28 wt-% Nb and balance WC, with a binder phase highly alloyed with W corresponding to a CW-ratio of 0.87, was coated with an innermost 0.5 µm equiaxed TiCN-layer with a high nitrogen content, corresponding to an estimated C/N ratio of 0.05, followed by a 4.3 µm

thick layer of columnar TiCN deposited using MT-CVD technique. In subsequent steps during the same coating process a 1.1 μm layer of Al_2O_3 consisting of pure κ-phase according to procedure disclosed in EP-A-523 021. A thin, 0.5 μm, TiN layer was deposited, during the same cycle, on top of the Al_2O_3-layer. The coated insert was brushed by a SiC containing nylon straw brush after coating, removing the outer TiN layer on the edge.

B. A cemented carbide turning tool insert in style CNMG120408-MM with the composition of 7.5 wt-% Co, 1.8 wt-% TiC, 3.0 wt-% TaC, 0.4 wt-% NbC, balance WC and a CW-ratio of 0.88. The cemented carbide had a surface zone, about 25 μm thick, depleted from cubic carbides. The insert was coated with an innermost 0.5 μm equiaxed TiCN-layer with a high nitrogen content, corresponding to an estimated C/N ratio of 0.05, followed by a 7.2 μm thick layer of columnar TiCN deposited using MT-CVD technique. In subsequent steps during the same coating process a 1.2 μm layer of Al_2O_3 consisting of pure κ-phase according to procedure disclosed in EP-A-523 021. A thin, 0.5 μm, TiN layer was deposited, during the same cycle, on top of the Al_2O_3-layer. The coated insert was brushed by a SiC containing nylon straw brush after coating, removing the outer TiN layer on the edge.

C. A competitive cemented carbide turning tool insert in style CNMG120408 from an external leading cemented carbide producer was selected for comparison in a turning test. The carbide had a composition of 9.0 wt-% Co, 0.2 wt-% TiC, 1.7 wt-% TaC, 0.2 wt-% NbC, balance WC and a CW-ratio of 0.90. The insert had a coating consisting of 1.0 μm TiC, 0.8 μm TiN, 1.0 μm TiC and, outermost, 0.8 μm TiN. Examination in light optical microscope revealed no edge treatment subsequent to coating.

D. A competitive cemented carbide turning tool insert in style CNMG120408 from an external leading cemented carbide producer was selected for comparison in a turning test. The cemented carbide had a composition of 5.9 wt-% Co, 3.1 wt-% TiC, 5.6 wt-% TaC, 0.1 wt-% NbC, balance WC and a CW-ratio of 0.95. The cemented carbide had a surface zone, about 30 µm thick, which was enriched in Co content. The insert had a coating consisting of 5.3 µm TiC, 3.6 µm TiCN, outermost, 2.0 µm TiN. Examination in light optical microscope revealed no edge treatment subsequent to coating.

E. A competitive cemented carbide turning tool insert in style CNMG120408 from an external leading cemented carbide producer was selected for comparison in a turning test. The carbide had a composition of 8.9 wt-% Co, balance WC and a CW-ratio of 0.84. The insert had a coating consisting of 1.9 µm TiC, 1.2 µm TiN, 1.5 µm Al_2O_3 laminated with 3 0.1 µm tick layers of TiN and, outermost, 0.8 µm TiN. Examination in light optical microscope revealed no edge treatment subsequent to coating.

F. A competitive cemented carbide turning tool insert in style CNMG120408 from an external leading cemented carbide producer was selected for comparison in a turning test. The carbide had a composition of 5.4 wt-% Co, 2.7 wt-% TiC, 3.5 wt-% TaC, 2.3 wt-% NbC, balance WC and a CW-ratio of 0.94. The cemented carbide had a surface zone, about 40 µm thick, which was enriched in Co content. The insert had a coating consisting of 5.3 µm TiC, 3.6 µm TiCN, outermost, 2.0 µm TiN. Examination in light optical microscope revealed no edge treatment subsequent to coating.

Inserts from A, B, C, D, E and F were compared in facing of a bar, diameter 180, with two, opposite, flat

sides (thickness 120 mm) in 4LR60 material. Feed 0.25 mm/rev, speed 180 m/min and depth of cut 2.0 mm.

The wear mechanism in this test is chipping of the edge. The inserts with gradient substrates (B, E and F) looked good after three cuts but broke suddenly after about four.

Insert	Number of cuts
A (acc. to invent.)	15
B (outside invention)	5
C (external grade)	9
D (external grade)	9
E (external grade)	4
F (external grade)	4

Example 2

Inserts A, and B from above were selected for a turning test, longitudinal and facing in machineability improved AISI304L stainless steel.

Cutting speed was 250 m/min, feed 0.3 mm/rev and depth of cut 2 mm. Cutting time 1 minute/cycle.

The wear mechanism was plastic deformation.

Insert	Number of cycles
B (outside invention)	7
A (acc. to invent.)	4

Example 3

G. Inserts in geometry TNMG160408-MM with composition and coating according to A above.

H. Inserts in geometry TNMG160408-MM with composition and coating according to B above.

I. Inserts in geometry TNMG160408 with composition and coating according to C above.

The inserts G, H and I were tested in longitudinal, dry, turning of a shaft in duplex stainless steel.

Feed 0.3 mm/rev, speed 140 m/min and depth of cut 2 mm. Total cutting time per component was 12 minutes.

Insert G and I got plastic deformation whereas insert H got some notch wear.

Two edges of insert G were worn out to produce one component whereas one edge of insert H completed one component and four edges were required to finalise one component using insert I.

Insert	Number of edges/component
H (outside invention)	1
G (acc. to invent.)	2
I (external grade)	4

Example 4

Inserts A and E from above were selected for a turning test, mainly facing, in a cover rotorcase made in cast AISI316 stainless steel. The cutting was interrupted due to component design.

Cutting speed was 180 m/min, feed 0.2 mm/rev and depth of cut 0-2 mm (irregular shape of casting). Cutting time 10.5 minutes/component.

The wear mechanism was a combination of edge chipping and plastic deformation.

Insert	Number of components
A (acc. to invent.)	2
E (external grade)	1

Example 5

Inserts according to A, B, C and D were selected for a turning test. Internal turning of AISI304 stainless steel valve substrate. Cutting speed was 130 m/min and feed 0.4 mm/rev. The stability was poor due to the boring bar.

The wear was chipping of the edge for inserts D and B whereas inserts A and C got plastic deformation.

Insert	Number of components
A (acc. to invent.)	9
D (external grade)	7
C (external grade)	5
B (outside invention)	2

Example 6

Inserts A and C from above were selected for a turning test, roughing of a square bar in AISI316Ti stainless steel. The cutting was interrupted due to component design.

Cutting speed was 142 m/min, feed 0.2 mm/rev, depth of cut 4 mm. and cutting time 0.13 minutes/component.

The wear was chipping of the edge.

Insert	Number of components
A (acc. to invent.)	25
C (external grade)	15

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Claims

1. A cutting tool insert particularly for turning of steel comprising a cemented carbide body and a coating c h a r a c t e r i s e d in that said cemented carbide body consists of WC, 6-15, preferably 9-12, wt-% Co and 0.2-1.8 wt-% cubic carbides of Ti, Ta and/or Nb and a highly W-alloyed binder phase with a CW-ratio of 0.78-0.93, preferably 0.80-0.91 and in that said coating comprises

- a first (innermost) layer of $TiC_xN_yO_z$ with a thickness of <1.5 µm, and with equiaxed grains with size <0.5 µm

- a layer of $TiC_xN_yO_z$ with a thickness of 2-5 µm with columnar grains with an average diameter of <5 µm-

- an outer layer of a smooth, fine-grained (0.5-2 µm) κ-Al_2O_3-layer with a thickness of 0.5-6 µm.

2. Cutting insert according to any of the preceding claims c h a r a c t e r i s e d in that the outermost layer is a thin 0.1-1 µm TiN-layer.

3. Cutting insert according to claim 2 c h a r a c t e r i s e d in that the outermost TiN-layer has been removed along the cutting edge.

4. Method of making an insert for turning comprising a cemented carbide body and a coating c h a r a c t e r i z e d in that a WC-Co-based cemented carbide body with a highly W-alloyed binder phase with a CW-ratio of 0.78-0.93 is coated with

- a first (innermost) layer of $TiC_xN_yO_z$ with x+y+z=1, preferably z<0.5, with a thickness of 0.1-1.5 µm, with equiaxed grains with size <0.5 µm using known CVD-methods

- a layer of $TiC_xN_yO_z$ with x+y+z=1, preferably with z=0 and x>0.3 and y>0.3, with a thickness of 2-8 µm with columnar grains with a diameter of about <5 µm deposited by MTCVD-technique, using acetonitrile as the carbon and

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nitrogen source for forming the layer in a preferred temperature range of 850-900 °C.

- a layer of a smooth κ-Al_2O_3 with a thickness of 0.5-6 μm and

- preferably a layer of TiN with a thickness of <1 μm.

5. Method according to the previous claim characterized in that said cemented carbide body has a cobalt content of 9-12 wt% and 0.4-1.8 wt% cubic carbides of Ta and Nb.

6. Method according to claim 4 or 5 characterised in that said cemented carbide body has a cobalt content of 10-11 wt%.

7. Method according to claim 4, 5 or 6 characterized in a CW-ratio of 0.82-0.90.

8. Method according to any of the claims 4, 5, 6 and 7 characterized in that the outermost TiN-layer, if present, is removed along the cutting edge.

Application No. Unassigned
Attorney's Docket No. 024444-497

ABSTRACT OF THE DISCLOSURE

A coated turning insert particularly useful for turning in stainless steel is disclosed. The insert is characterized by a WC-Co-based cemented carbide substrate having a highly W-alloyed Co-binder phase and a coating including an inner layer of $TiC_xN_yO_z$ with columnar grains followed by a layer of fine-grained κ-Al_2O_3 and a top layer of TiN. The layers are deposited by using CVD-methods.

#3

COMBINED DECLARATION FOR PATENT APPLICATION AND POWER OF ATTORNEY (Includes Reference to Provisional and PCT International Applications)	ATTORNEY'S DOCKET NUMBER 024444-497

As a below named inventor, I hereby declare that:
My residence, post office address and citizenship are as stated below next to my name;
I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

COATED TURNING INSERT AND METHOD OF MAKING IT

the specification of which (check only one item below):

☐ is attached hereto.

☒ was filed as United States application

Number _____

on May 28, 1998

and was amended

on _____ (if applicable).

☐ was filed as PCT international application

Number _____

on _____

and was amended under PCT Article 19

on _____ (if applicable).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose to the Office all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, §1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, §119 (a)-(e) of any foreign application(s) for patent or inventor's certificate or of any PCT international application(s) designating at least one country other than the United States of America listed below and have also identified below any foreign application(s) for patent or inventor's certificate or any PCT international application(s) designating at least one country other than the United States of America filed by me on the same subject matter having a filing date before that of the application(s) of which priority is claimed:

PRIOR FOREIGN/PCT APPLICATION(S) AND ANY PRIORITY CLAIMS UNDER 35 U.S.C. §119:

COUNTRY (if PCT, indicate "PCT")	APPLICATION NUMBER	DATE OF FILING (day, month, year)	PRIORITY CLAIMED UNDER 35 U.S.C. §119
PCT	PCT/SE96/01578	29 November 1996	X Yes __ No
Sweden	9504304-8	30 November 1995	X Yes __ No
Sweden	9602413-8	17 June 1996	X Yes __ No
			__ Yes __ No
			__ Yes __ No

I hereby claim the benefit under Title 35, United States Code § 119(e) of any United States provisional application(s) listed below.

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(Application Number) (Filing Date)

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COMBINED DECLARATION FOR PATENT APPLICATION AND POWER OF ATTORNEY (CONTINUED) (Includes Reference to Provisional and PCT International Applications)	ATTORNEY'S DOCKET NO. 024444-497

I hereby claim the benefit under Title 35, United States Code, §120 of any United States applications(s) or PCT international application(s) designating the United States of America that is/are listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in that/those prior application(s) in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose to the Office all information known to me to be material to the patentability as defined in Title 37, Code of Federal Regulations §1.56, which became available between the filing date of the prior application(s) and the national or PCT international filing date of this application:

PRIOR U.S. APPLICATIONS OR PCT INTERNATIONAL APPLICATIONS DESIGNATING THE U.S. FOR BENEFIT UNDER 35 U.S.C. 120:

U.S. APPLICATIONS		STATUS *(check one)*		
U.S. APPLICATION NUMBER	U.S. FILING DATE	PATENTED	PENDING	ABANDONED

PCT APPLICATIONS DESIGNATING THE U.S.

PCT APPLICATION NO.	PCT FILING DATE	U.S. APPLICATION NUMBERS ASSIGNED (if any)			

I hereby appoint the following attorneys and agent(s) to prosecute said application and to transact all business in the Patent and Trademark Office connected therewith and to file, prosecute and to transact all business in connection with international applications directed to said invention:

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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

COMBINED DECLARATION FOR PATENT APPLICATION AND POWER OF ATTORNEY (CONTINUED) (Includes Reference to Provisional and PCT International Applications)	ATTORNEY'S DOCKET NO. 024444-497

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